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Remarks:

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(54) Illumination key and method of manufacture thereof

(57) The present invention provides an illumination key and a method of making such illumination key, which makes it possible to reliably recognize a printed pattern (character) on the upper side of key top even when the upper surface of the key top is slanted or curved, in which a key operating portion is given a rubber-like click sensitivity and a rubber-like elasticity, the key top portion is made from a rigid resin, and reliably strong bond is created between the key operating portion and the key top, and provides an illumination key that can reliably achieve ON/OFF operations while making it possible to reduce the weight of the key top without reducing the bonding strength between the keytop and the key operating portion.

The illumination key of the present invention com-

prises a partial transmission white-colored membrane or colored partial transmission type light reflecting membrane formed on an upper surface of the transparent resin key top excluding the underside surface of the key top;

a pattern formed on an upper surface of the partial transmission type light reflecting membrane;  
an opaque layer covered the upper and side surfaces of the key top excluding the pattern formed portion;  
a transparent protection layer formed on the upper and side surfaces of the opaque layer; and  
an upper surface of the key operating portion made from a transparent rubber or thermoplastic elastomer being fixed to the underside surface of the key top by means of a transparent adhesive.

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## Description

### BACKGROUND OF THE INVENTION

#### Field of the Invention

[0001] The present invention relates to an illumination key for use in various mobile communication devices, such as cellular phones and automobile phones, and various terminal devices, such as electronic organizers and the like, to enable the keys thereof to be visible in nighttime and low light conditions. The present invention further relates to a method of manufacturing such illumination key.

#### Description of the Prior Art

[0002] In the prior art, this type of illumination key is constructed by forming a printed pattern layer, such as a character or the like, into the underside surface of a key top made of light-permeable resin and then fixing a silicon rubber key operating portion to the back side of the printed pattern layer by means of silicon rubber and an adhesive having good adhesive properties.

[0003] Further, because prior art illumination keys are not designated to allow for reduction in size and weight of the key unit when manufacturing thin keytops, it is not possible to meet the market needs for ultralight keytops.

[0004] Moreover, because the printed pattern (character) layer is formed in the underside surface of the light-permeable resin key top, the printed pattern (character) is difficult to see in the illumination key described above in the case where the upper surface of the key top has a curved shape.

[0005] Furthermore, when designing a lightweight keytop, it is difficult to adequately bond the keytop and the key operating portion.

#### SUMMARY OF THE INVENTION

[0006] With a view towards overcoming the problems of the prior art discussed above, it is an object of the present invention to provide an illumination key which makes it possible to reliably recognize a printed pattern (character) on upper side of the key top even when the upper surface of the key top is slanted or curved, in which a key operating portion is given a rubber-like click sensitivity and a rubber-like elasticity, the key top portion is made from a rigid resin, and a reliably strong bond is created between the key operating portion and the key top.

[0007] Furthermore, it is an object of the present invention to provide an illumination key that can reliably achieve ON/OFF operations while making it possible to reduce the weight of the keytop without reducing the bonding strength between the keytop and the key operating portion.

[0008] Further, in the illumination key according to the

present invention, it is possible to form a partial transmission type light reflection membrane having a white color or the like on all surfaces excluding the underside surface of the light-permeable resin key top, with the printed pattern (character) layer being formed in the upper surface of such a partial transmission type reflection membrane. In this case, except for the printed pattern (character) portion, an opaque layer is provided to cover the upper and side surfaces of the key top, with the upper and side surfaces of the opaque layer being covered by a transparent protection layer. And as before, a transparent adhesive is used to fix the underside surface of the key top to the upper surface of a key operating portion made of light-permeable silicon rubber or thermoplastic elastomer.

[0009] Further, in the illumination key according to the present invention, it is possible to use a thin key top made from a white-colored or a colored partial light-permeable resin, with the printed pattern (character) being formed on a surface of the key top which excludes the underside thereof. And as before, a transparent adhesive is used to fix the underside surface of the key top to the upper surface of a key operating portion made of light-permeable silicon rubber or thermoplastic elastomer.

[0010] In the illumination key according to the present invention, an operating shaft is formed at a central portion of the underside of a transparent resin keytop mounted and bonded on top of a key operating portion formed from a transparent rubber or thermoplastic elastomer, and a cavity portion is formed in the underside of the keytops in order to make the keytop thinner.

[0011] Further, as stated in Claim 3, the transparent resin keytop formed with the operating shaft is formed from a hard foaming resin such as polyurethane foam or the like.

[0012] Furthermore, the lower portion of the operating shaft of the transparent resin keytop described in Claim 3 is fitted into a concave portion formed in a central upper surface portion of the transparent rubber or thermoplastic elastomer key operating portion, with such fitting portion being bonded by a transparent adhesive.

[0013] Further, in the illumination key according to the present invention, a protruding portion is formed at the central upper surface portion of the transparent rubber or thermoplastic elastomer key operating portion, and also formed in such central portion is an insertion hole into which is fitted the operating shaft of the transparent resin keytop described in Claim 3, with such fitting portion being bonded by a transparent adhesive.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Fig. 1 is a cross-sectional schematic view of one embodiment of the present invention.

[0015] Fig. 2 is a cross-sectional schematic view of another embodiment of the present invention.

[0016] Fig. 3 is a cross-sectional schematic view of

another embodiment of the present invention.

[0017] Fig. 4 is a cross-sectional schematic view of another embodiment of the present invention.

[0018] Fig. 5 is a cross-sectional schematic view of another embodiment of the present invention.

[0019] Fig. 6(a) is a cross-sectional schematic view of another embodiment of the present invention.

[0020] Fig. 6(b) is a cross-sectional schematic view of another embodiment of the present invention.

[0021] Fig. 7(a) is a cross-sectional schematic view of another embodiment of the present invention.

[0022] Fig. 7(b) is a cross-sectional schematic view of another embodiment of the present invention.

[0023] Fig. 8(a) is a cross-sectional schematic view of another embodiment of the present invention.

[0024] Fig. 8(b) is a cross-sectional schematic view of another embodiment of the present invention.

[0025] Fig. 9(a) is a cross-sectional schematic view of another embodiment of the present invention.

[0026] Fig. 9(b) is a cross-sectional schematic view of another embodiment of the present invention.

[0027] Fig. 10 is a cross-sectional schematic view of another embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] A detailed description of a preferred embodiment of the present invention will now be given below.

[0029] As shown in the drawings, a light-permeable key pad 1 has an operating portion 1a and a non-operating portion 1b connected to the operating portion 1a formed as an integral body from transparent silicon rubber, other transparent rubber or transparent thermoplastic elastomer such as vinyl chloride based elastomer, polyolefin base elastomer, polystyrene-polybutadiene copolymer thermoplastic elastomer, ethylene vinyl acetate elastomer, chlorinated polyethylene elastomer, polyurethane rubber or the like. By forming the keypad 1 from rubber or a thermoplastic elastomer, it is possible to utilize the rubber-like characteristics to obtain click-sensitivity and rapid operation sensitivity with the operating portion 1a. Further, in addition to the case shown in Fig. 1, in which the operating portion 1a is formed from a thin skirt portion 1c, which rises up along a slant from the upper portion of the side surface of the non-operating portion 1b, and a key top support portion 1d which is integrally supported at the upper portion of the skirt portion 1c, it is possible to construct the operating portion 1a in which forms the erect thin skirt portion 1b toward the upper slanting portion thereof, or, as shown in Fig. 2, the slanting skirt portion is eliminated and the key top supporting portion 1d extends out horizontally from a thick side surface of the non-operating portion 1b. In this connection, it should be noted that the present invention is not limited to these structures, and it is possible to utilize any other structure so long as it is possible to support a key top 2. In the case where a skirt portion 1c

is provided, this skirt portion 1c carries out a click action.

[0030] Further, the operating portion 1a is arranged above a substrate (not shown in the drawings) at a position corresponding to a fixed contact point on the substrate, with a rubber click structure being created by forming an electrically conductive contact member on the underside of the operating portion 1a, or with a dome click structure being created by means of a dome switch such as a metal dome switch (not shown in the drawings).

[0031] The key top 2, made from a thermoplastic resin such as ABS, polycarbonate, acrylic resin or the like, is fixedly mounted to the top of the key top support portion 1d by means of a transparent adhesive 3. In this connection, the upper surface of the key top 2 may have any of a variety of shapes, such as a curved shape which slants in one direction, for example. Further, the lower portion of the key top 2 may be formed to include a brim portion 2a, as shown in Fig. 3, or the lower portion of the key top 2 may be formed without such a brim portion. In general, to enable light to pass through the key top 2, a transparent or translucent material around 1mm thick (e.g., in the range 0.8mm - 1.5mm) is used to make the key top 2, and in this regard it is possible to use a white-colored material which allows light at a certain intensity to pass therethrough. In the case where the key top 2 is formed from such partially light-permeable white-colored material, there is no need to form the partial transmission light reflecting membrane 4a described below.

[0032] The transparent adhesive 3 is an adhesive used to bond the key top 2, made of a thermoplastic resin such as ABS, polycarbonate, acrylic resin or the like, with the key pad 1, made of a silicon rubber or other rubber material or thermoplastic elastomer, which is an integral body formed from the operating portion 1a and the non-operating portion 1b. In this connection, the adhesive 3 may be any adhesive which makes it possible to bind two different materials together; for example, it is possible to use a silicon type transparent adhesive in the case of silicon rubber.

[0033] Further, with the exception of the underside surface, a printed pattern (character) layer 4 is formed in the surface of the key top.

[0034] A partial transmission light reflecting membrane 4a having a bright color to reflect white light and the like is formed on all surfaces the light permeable resin key top 2 except for the underside surface thereof. For example, it is possible to use a white coating as the partial transmission light reflecting membrane. Next, a solid chromatic color printing is carried out in red, blue, yellow or the like to form a pattern comprised of a letters, symbols, figures or the like, with all of the solid printing 4b except for the portion containing the pattern being covered by a black opaque membrane 4c. Forming of pattern (character or the like) may be formed using laser or the like. Further, the opaque membrane 4c and the portion of the solid printing 4b which contains the pattern (character or the like) is covered by a transpar-

ent protective membrane 5 formed from a transparent resin such as urethane or the like.

**[0035]** The printed pattern layer 4 may be formed to have either a positive condition, in which only the etched character (pattern) portion is printed in a chromatic color, or a negative condition in which all of the printed pattern layer 4 except for the etched character (pattern) is colored.

**[0036]** Further, in the case where the body of the resin key top 2 is formed to have a thickness around 1mm, it is possible to use the above method to form a printed pattern (character) layer 4 without having to apply a white-colored coating to the surface of the key top 2 so long as it is possible for the body of the key top 2 to reflect white light and the like and at the same time allow light at a certain intensity to pass therethrough.

**[0037]** Then, after forming the printed pattern layer 4 in the upper surface of the key top 2, the underside surface of the key top 2 is fixed to the upper surface of a key operating portion 1a of a key pad 1 by means of the transparent adhesive 3.

**[0038]** Next, the means for making the illumination key ultralight will be described.

**[0039]** As is structurally shown in Figs. 5 - 10, an operating shaft 9 is integrally formed at a central portion of the underside of the transparent keytop 2 which is mounted and bonded to the top of the transparent rubber or thermoplastic elastomer key operating portion 1b. Further, a cavity 10 for making a thin keytop 2 is carved out to form a circular space to receive the operating shaft 9 of the underside of the keytop 2. Further, the thickness of the underside of the keytop 2 should have roughly the same thickness structure. The material used for the keytop 2 should be chosen so as to prevent the keytop 2 from being indented when the keytop 2 is struck by a finger. Of course, the contact surfaces of the keytop 2 and the key operating portion 1a are fixed by means of a transparent adhesive.

**[0040]** By forming the operating shaft 9 on the underside of the keytop 2, it is possible to guarantee reliable ON/OFF operations of the key operating portion 1b when the keytop 2 is pressed with a finger or the like.

**[0041]** When selecting a material for the keytop 2, in order to achieve an even higher reduction in weight, the transparent resin keytop 2 shown in Fig. 9 should preferably be formed from a hard foaming resin such as polyurethane foam or the like.

**[0042]** In order to vastly improve the bonding strength when fixing the contact surfaces of the keytop 2 and the key operating portion 1a by means of a transparent adhesive 3, the lower portion of the operating shaft 9 of the transparent resin keytop 2 is fitted into the concave portion 1g formed in the central upper portion of the transparent rubber or thermoplastic elastomer key operating portion 1a. In this way, because a vertical bonding is carried out on the fitting portion 11 of the lower portion of the operating shaft 9 fitted into the concave portion 1g, it is possible to achieve an increase in bonding strength

several times higher compared to horizontal bonding.

**[0043]** To further increase the bonding strength, a protruding portion 1e as shown in Fig. 10 is formed on a central portion of the upper surface of the transparent rubber or thermoplastic elastomer key operating portion 1b, and an insertion hole 1f is formed in the central portion of the protruding portion 1e into which the operating shaft 9 of the transparent resin keytop 2 is fitted and vertically bonded by the application of a transparent adhesive.

**[0044]** In Fig. 9, the number 12 indicates a PET or a metal dome switch.

**[0045]** Now, by having the structure described above, the illumination key according to the present invention makes it possible to reliably recognize the character (pattern) on the key top 2 even when the upper surface of the key top 2 has a curved or slanting shape, as the character (pattern) is formed on upper surface of the key top. Furthermore, because the key operating portion creates a rubber-like click sensitivity and a rubber-like elasticity while the resin of the key top portion is made rigid, and because it is possible to reliably achieve a strong bond between the key operating portion and the key top, the illumination key according to the present invention makes it possible to reliably carry out key operations by preventing misoperations and other problems such as peeling or the like.

**[0046]** In particular, the structure described above makes the illumination key according to the present invention suitable for use in thin-type devices such as cellular phones and the like.

**[0047]** Further, by forming the thin resin key top with partially light-permeable white-colored material, it is not necessary to form a partial transmission type light reflection membrane on the surface of the key top, and also it is easier to recognize the pattern as the key top itself diffuses light uniformly.

**[0048]** Further, because the lower portion of the operating shaft of the keytop is fitted into the concave portion formed in the central portion of the upper surface of the key operating portion when the contact surfaces of the keytop and key operating portion are bonded together, it is possible to carry out a vertical bonding, and this makes it possible to improve the bonding strength by several times in addition to that achieved by horizontal bonding, whereby it becomes possible to increase the bonding strength for a small amount of contact surface. Furthermore, by forming a protruding portion on the central portion of the upper surface of the key operating portion, and by fitting and bonding the operating shaft of the keytop into the insertion hole of such protruding portion, it is possible to achieve an even higher effective bonding.

**[0049]** Further, in the present invention, by forming an operating shaft at the central portion of the underside of the keytop and a cavity around the periphery of such operating shaft, it becomes possible to make a thin keytop, whereby it becomes possible to reduce the entire

weight of the key. Furthermore, by forming the keytop from a hard foaming resin, it is possible to achieve an even higher reduction in weight while preventing the keytop from being indented when struck.

[0050] Finally, it is to be understood that many changes and additions may be made to the embodiments described above without departing from the scope and spirit of the invention as defined in the appended Claims.

## Claims

### 1. An illumination key, comprising:

a partial transmission white-colored membrane or colored partial transmission type light reflecting membrane formed on an upper surface of the transparent resin key top excluding the underside surface of the key top;  
a pattern formed on an upper surface of the partial transmission type light reflecting membrane;  
an opaque layer covered the upper and side surfaces of the key top excluding the pattern formed portion;  
a transparent protection layer formed on the upper and side surfaces of the opaque layer; and  
an upper surface of the key operating portion made from a transparent rubber or thermoplastic elastomer being fixed to the underside surface of the key top by means of a transparent adhesive.

### 2. An illumination key, comprising:

a relatively thin key top made of white-colored resin key top or resin key top colored with partial transmission type light reflecting coloring agent;  
a pattern formed on an upper surface of the key top excluding the underside of the key top;  
an opaque layer covered the upper and side surfaces of the key top excluding the pattern formed portion;  
a transparent protection layer formed on the upper and side surfaces of the opaque layer; and  
an upper surface of the key operating portion made from a transparent rubber or thermoplastic elastomer to the underside surface of the key top by means of a transparent adhesive.

### 3. An illumination key, comprising:

a key operating portion made of transparent rubber or thermoplastic elastomer;  
a transparent resin keytop mounted and bonded to the top of the key operating portion;  
an operating shaft formed on a central portion

of the underside of the keytop; and  
a cavity formed on the underside of the keytop to reduce the thickness of the keytop.

4. The illumination key of Claim 3, wherein the transparent resin keytop is formed from a hard foaming resin such as polyurethane foam or the like.
5. The illumination key of Claim 3, wherein a lower portion of the operating shaft of the transparent resin keytop is fitted into a concave portion formed in a central portion of the upper surface of the transparent rubber or thermoplastic elastomer key operating portion, with such fitting portions being bonded by means of a transparent adhesive.
6. The illumination key of Claim 3, further comprising a protruding portion formed at a central portion of the upper surface of the transparent rubber or thermoplastic elastomer key operating portion and an insertion hole formed in the protruding portion, wherein the operating shaft of the transparent resin keytop is fitted into the insertion hole and bonded in place by means of a transparent adhesive.

FIG. 1

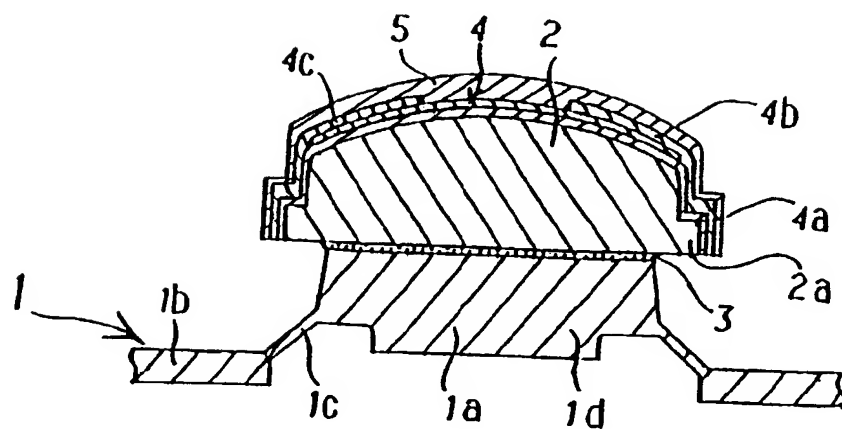


FIG. 2

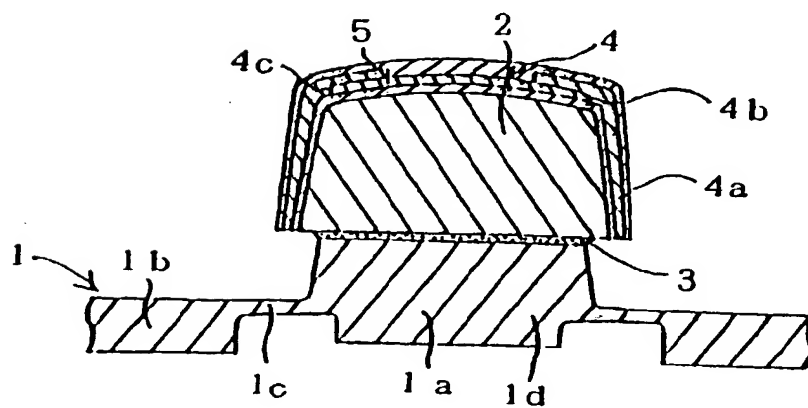


FIG. 3

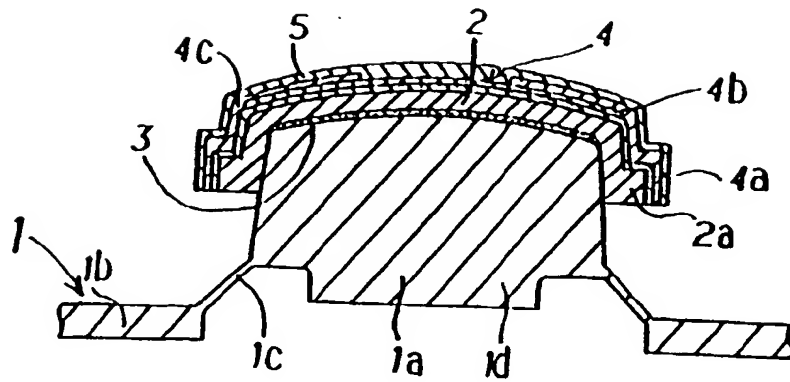


FIG. 4

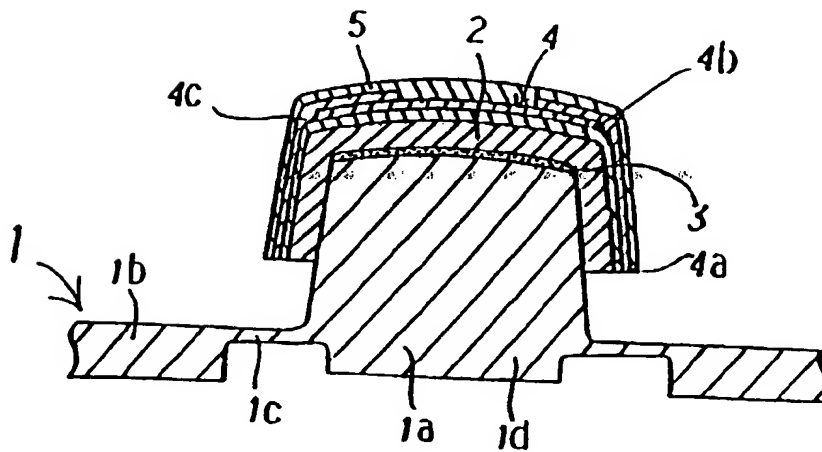


FIG. 5

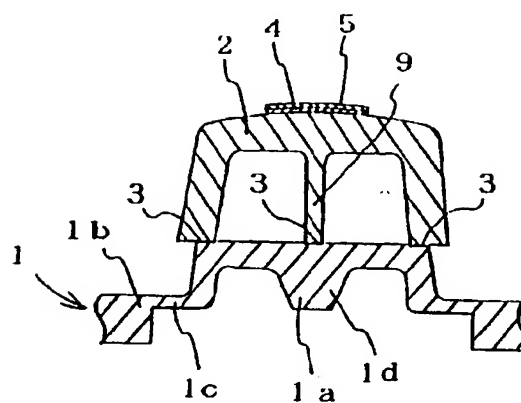
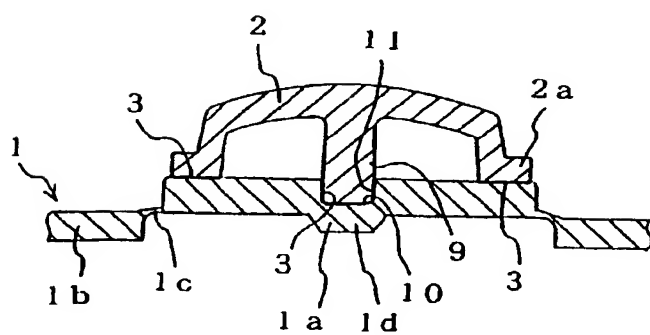


FIG. 6

(a)



(b)

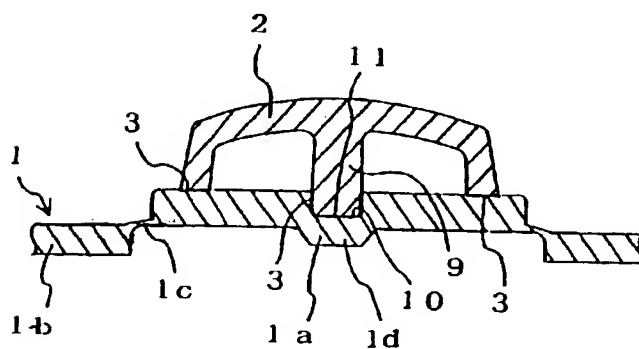
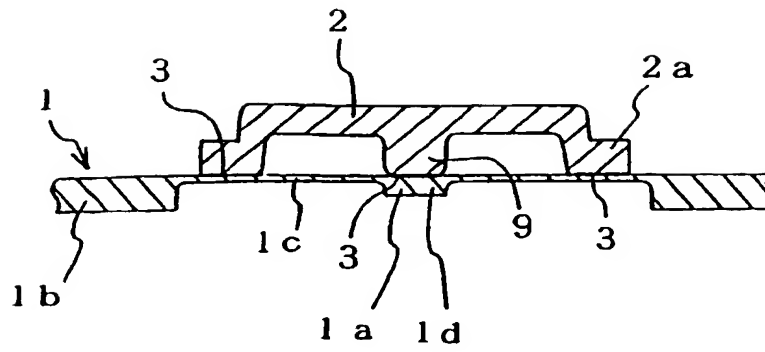




FIG. 7

(a)



(b)

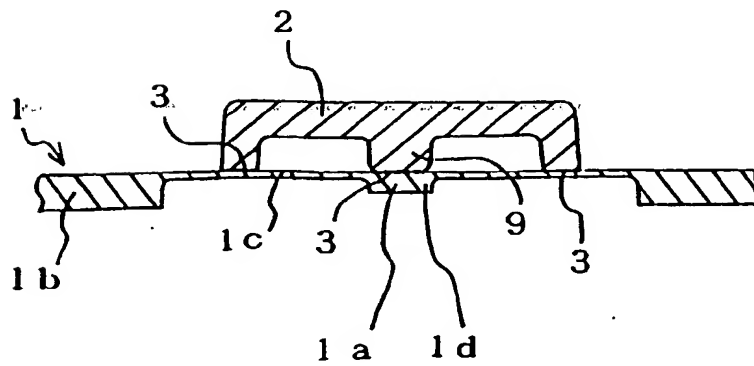
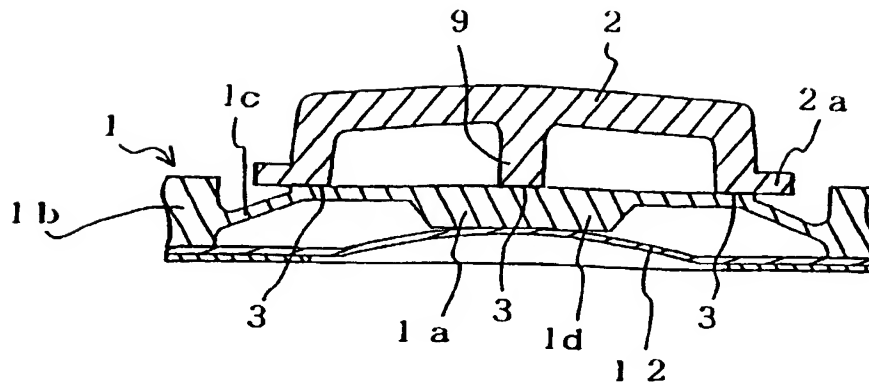


FIG. 8

(a)



(b)

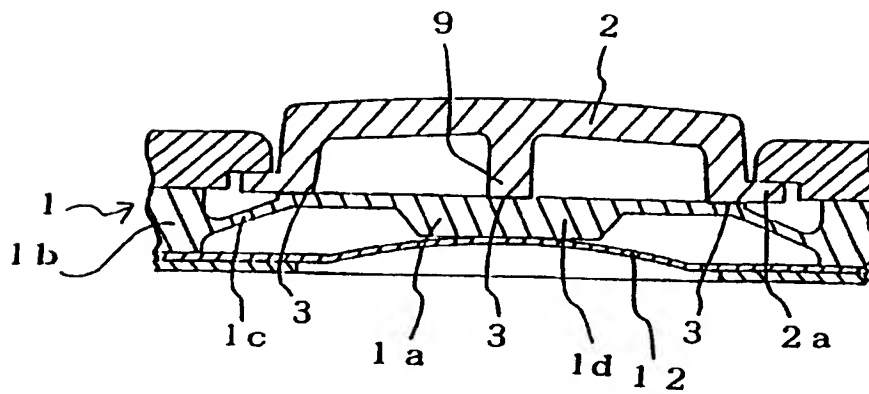
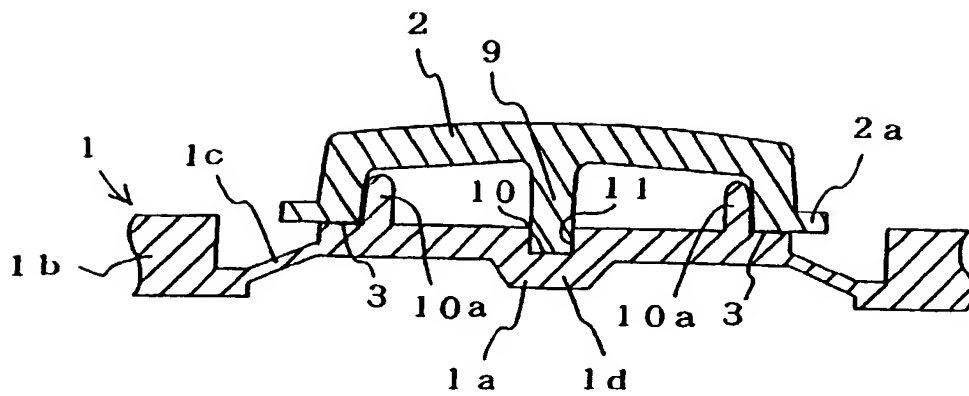




FIG. 10





European Patent  
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# EUROPEAN SEARCH REPORT

Application Number  
EP 99 11 0963

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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The present search report has been drawn up for all claims			
Place of search <b>MUNICH</b>		Date of completion of the search <b>12 July 1999</b>	Examiner <b>Mausser, T</b>
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